May 5, 1964 J. CLASEN ETAL 3,131,923

DOOR HAVING SWINGING DOOR WINGS

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Fig. 1

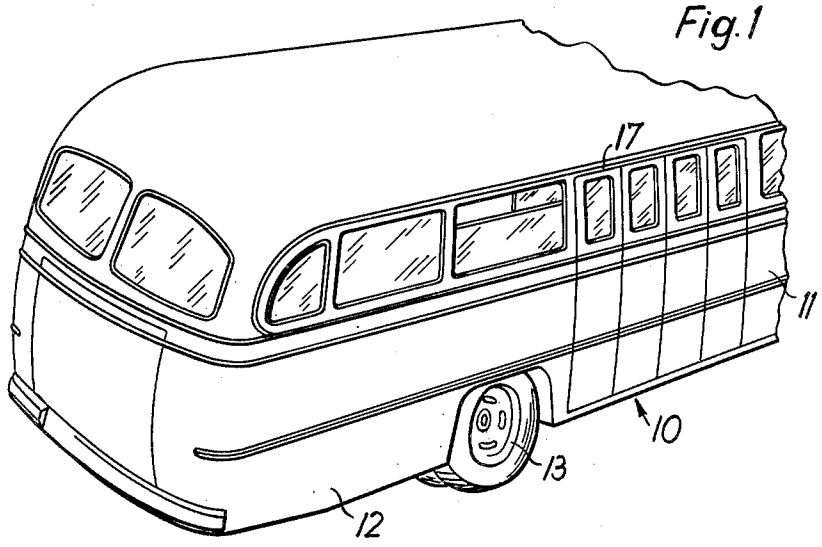
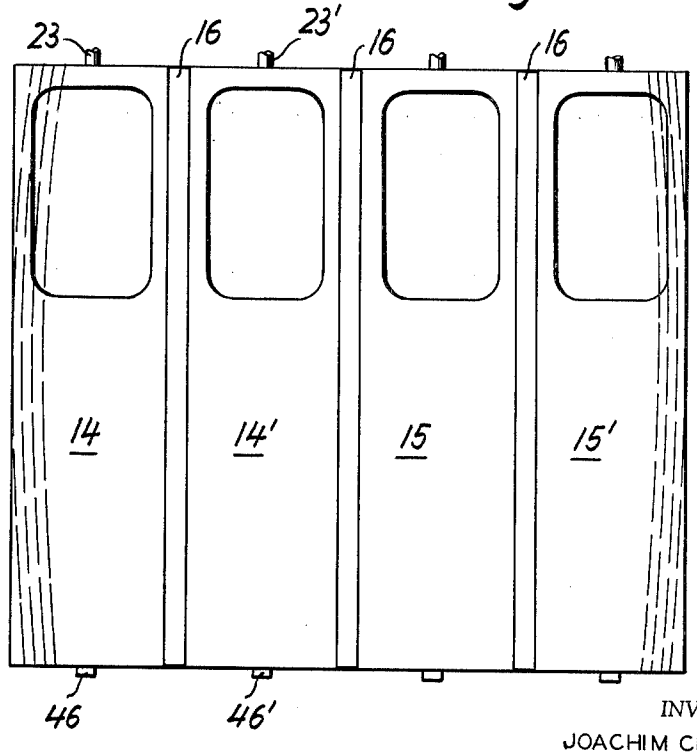



Fig. 2




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DOOR HAVING SWINGING DOOR WINGS

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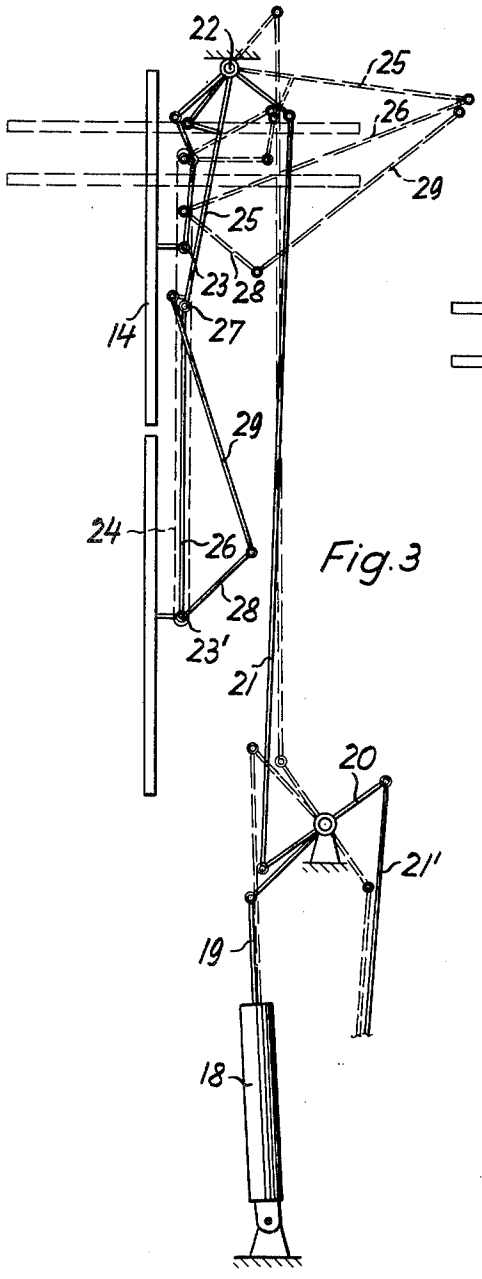
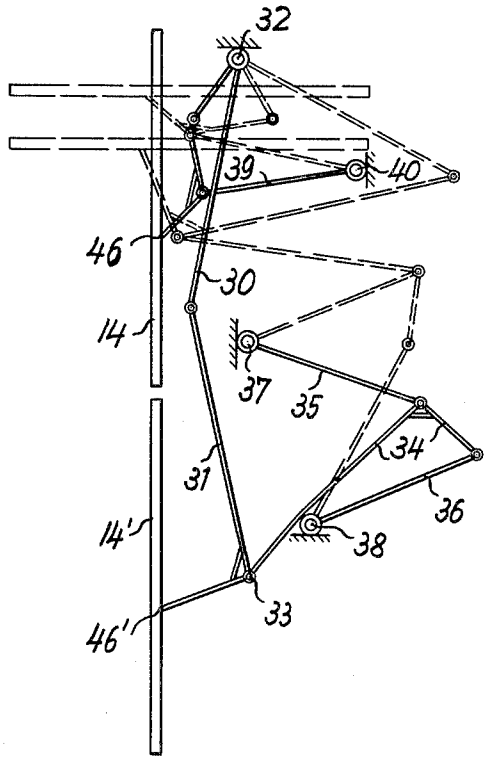



Fig. 3

Fig. 4




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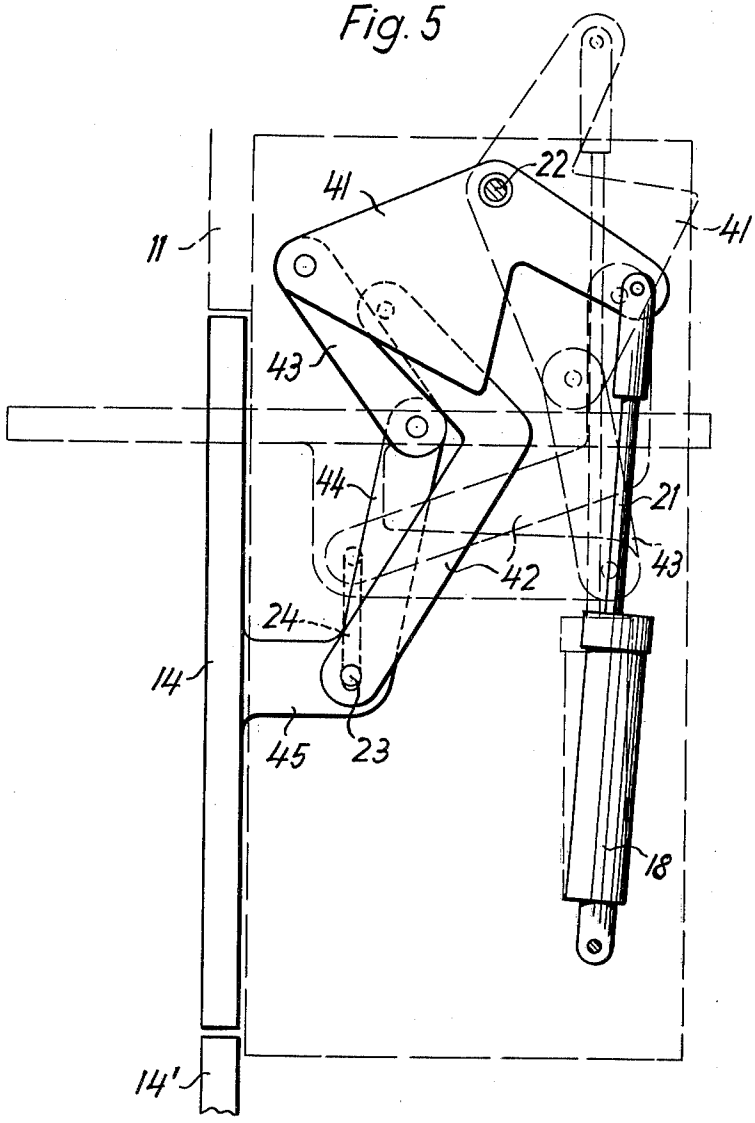
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DOOR HAVING SWINGING DOOR WINGS

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Fig. 5




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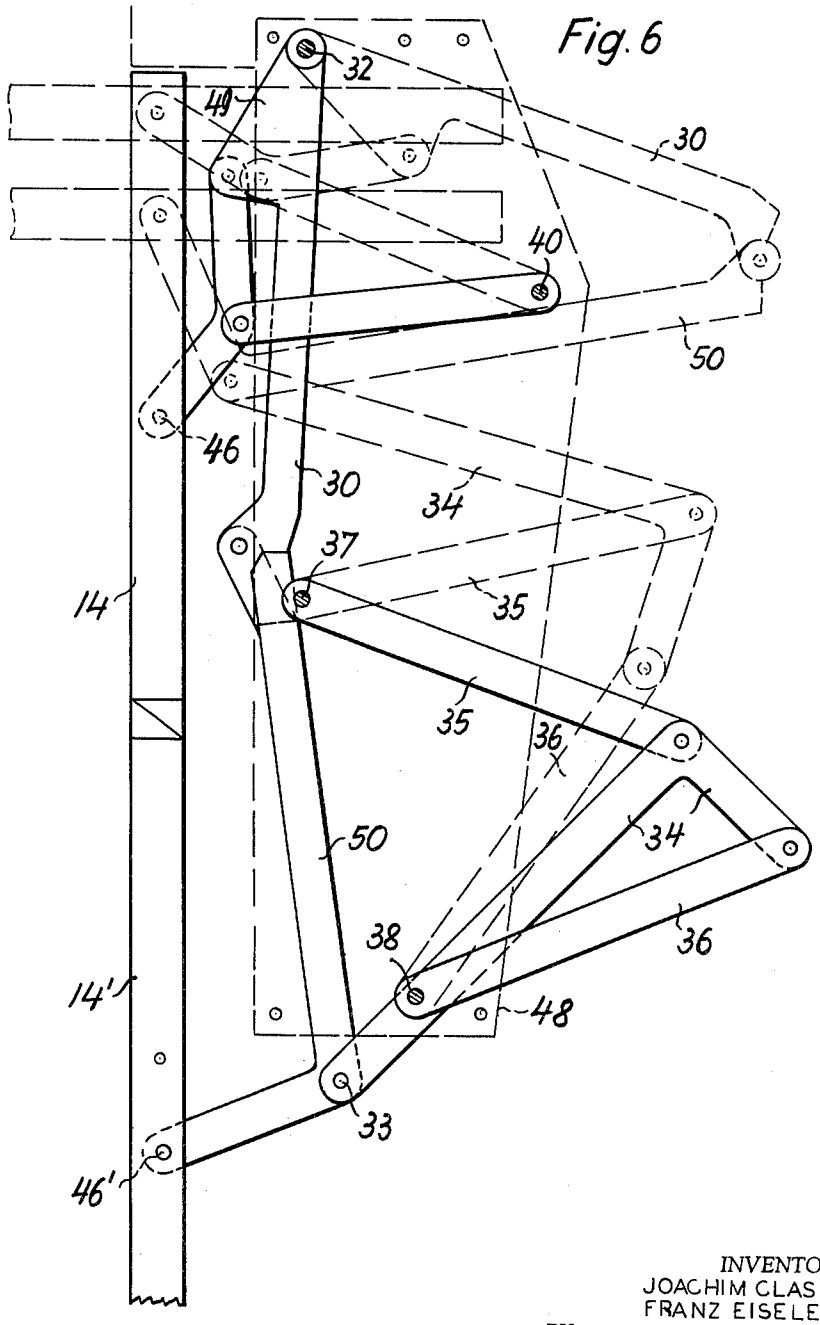
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DOOR HAVING SWINGING DOOR WINGS

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Fig. 6




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DOOR HAVING SWINGING DOOR WINGS

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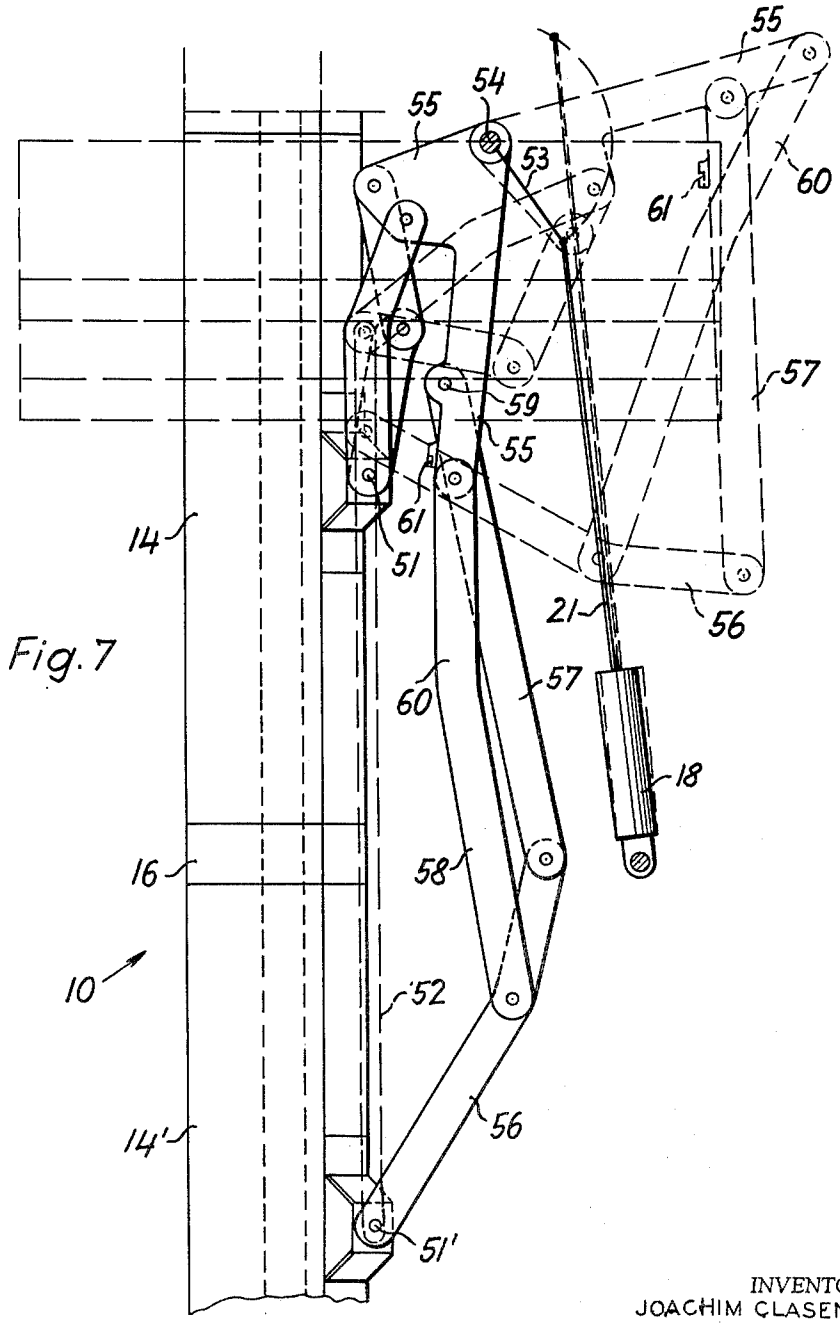



Fig. 7

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United States Patent Office 3,131,923 Patented May 5, 1964



3,131,923

# DOOR HAVING SWINGING DOOR WINGS

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16 Claims. (Cl. 268—30)

The present invention relates to a door, especially for vehicles such as buses, train coaches, streetcars, and the like, and particularly to a door with two or more equal swinging door wings which may be applied either to a vehicle with flat outer walls or with curved walls, and which in the closed position extends flush with the respective outer wall of the vehicle, while for opening the door, the door wings are turned individually about a vertical axis and are at the same time moved in the longitudinal direction of the vehicle toward one or the other side of the door opening.

Folding doors of a somewhat similar type were known prior to this invention and consisted of several door wings which were connected to each other by hinges and therefore opened by being folded toward each other while being shifted at the same time in the longitudinal direction of the vehicle toward one side or the other of the door opening. These folding door structures had the disadvantage that they could be used only for vehicles with flat walls and that they also required relatively large door niches for accommodating the folded door wings.

It is an object of the present invention to provide a door and an operating mechanism therefor, which comprises two or more swinging door wings which may be moved to a closed position in which they will be entirely flush with the outer wall of the vehicle regardless of whether such outer wall is perfectly flat or whether it is curved so as to give it a more pleasant or streamlined shape. In other words, the door according to the invention may have the same outer contours as the remainder of the wall of the vehicle adjacent to the door, and will form a uniform, unbroken surface with the remainder of the outer wall of the vehicle regardless of the particular shape of the latter.

Another object of the invention is to provide a door structure as above described which requires only shallow niches for accommodating the door in its open position and allows the door wings to be opened to the fullest extent so as to leave the largest possible opening commensurate with the size of the frame of the door opening.

These objects are attained according to the invention by suspending each individual door wing on the upper side of the frame of the door opening which also supports the top of the vehicle, and by providing suitable means for turning each of the door wings, which are adapted to open toward the same side of the door opening, in the same direction about a vertical axis which is preferably disposed substantially at the center of the door wing, and for shifting these door wings simultaneously with such turning movement longitudinally of the vehicle toward one side or the other until, when the door is completely open, the door wings on each side of the door opening will be substantially in engagement with and parallel to each other, extending at substantially right angles to the outer wall of the vehicle and being turned so that their normal inner sides face toward the center of the door opening.

Due to the fact that the door wings, which, when being opened, are movable toward the same side of the door opening, are not hinged to each other but, while moving laterally, are turned individually in the same direction, they can be fitted closely against each other, and when curved, even closely into each other, so that the opening which is attained when the door is fully opened will be of substantially the same size as the opening of the door frame. This new type of door and the operating mechanism therefor also permit the door to be of any desired size or to be composed of any desired number of individual door wings. A very wide door may therefore easily be divided into any desired number of equal door wings of a small width so that the door niches into which the door wings are pushed when in the open position may have a relatively shallow depth toward the inside of the vehicle, while the open door wings may then project very little, if any, beyond the outer wall of the vehicle.



The new type of door may therefore also consist of more than two equal door wings which may be opened symmetrically and simultaneously from the center of the entire door toward both sides of the door opening. It is then advisable according to the invention to provide each individual door wing with a pilot pin or the like by means of which the door wing is suspended and guided within a guide rail which is mounted on the frame supporting the vehicle top. All of these door wings may then be operated through suitable connecting means by a single power source, for example, that of a single cylinder, the piston of which may be operated either pneumatically or hydraulically. Of course, these common drive means may also consist of any other suitable means, such as mechanical, electromagnetic or motor-driven means. They may also be located remote from the door and their power may be transmitted to the actual door operating mechanism by connecting rods, chains, cables, or the like. These operating means including the connecting means only need to be provided at one side of the door wings, preferably the upper side while the opposite side of the door wings, preferably the lower side, may be guided by suitable connecting means so as to carry out the same movement as the driven side.

According to one preferred embodiment of the invention, the pneumatic or hydraulic cylinder may be pivotably mounted on the frame supporting the vehicle top, and the piston rod thereof may be pivotably connected through a double crank and a pair of connecting rods to two bell cranks which are pivotable about fixed pivots at the opposite sides of and above the door frame, and are connected through suitable levers to the individual door wings so as to turn all of the door wings simultaneously and to shift them at the same time toward the opposite sides of the door opening. The drive mechanism may also be simplified by pivotally connecting the piston rod at both sides of the door opening directly to the bell crank. Instead of pivotably mounting the bell crank on a fixed pivot and pivotably connecting the piston rod or the connecting rod from the double crank thereto, it is also possible to provide a journal which is rotatably mounted at a fixed point and has an arm rigidly thereon which is pivotably connected to the piston rod, while the bell crank which is connected through intermediate links to the door wings forming one-half of the door is, in turn, rigidly secured to such journal and pivoted therewith.

At their bottom ends, the door wings are likewise connected through intermediate links to a bell crank which is mounted in a fixed position. Similar to the upper lever arrangement, each of these links together with the bell crank thereon forms a bendable knee lever. The ends of these links are further connected to other guide levers which are pivotable about fixed pivot points in such a manner that, when the operating means act upon the upper pilot studs, these movements will be transmitted through the door wings to the lower sides thereof, and the points thereon corresponding to the upper pilot studs

will be positively guided by the lever arrangement to carry out the same movements. By the additional guide levers it is thus possible to omit a guide rail at the lower side of the door which would have the disadvantage of easily getting soiled and clogged.

According to a further embodiment of the invention, the lever or linkage mechanism for opening and closing the door may also be designed so as to take up very little space at the inside of the vehicle when the door is in the open position. This has the particular advantage that the free height within the vehicle will not be reduced by the lever mechanism, so that it is also possible, for example, in a bus, to provide a continuous baggage rack or the like even over the door opening.

This may be attained by designing the knee-lever arrangement for opening and closing the door so as to consist of at least one door-turning and shifting lever which is secured to the door wing adjacent to the center of the door and is connected to a bell crank by means of two intermediate links which are pivotably mounted on the mentioned lever and on the bell crank at a certain distance from each other. This bell crank is then connected to the piston rod of the pneumatic or hydraulic cylinder so as to be pivoted thereby to carry out the opening and closing movements of the door wings. The lever on the door wing and the bell crank are preferably made of substantailly the same length which may be equal to aboiut one-half of the width of the door wing.

This lever arrangement is preferably designed so that one intermediate link is pivotably connected at one end to the end of the lever on the door wing and at the other end to the bell crank at a certain distance from the end thereof, while the other intermediate link is pivotably connected to the door wing lever and to the bell crank at an inverse relation to the first intermediate link, that is, at one end to the end of the bell crank and at the other end to the door wing lever at a certain distance from the end thereof which carries the first intermediate link. This first link is also preferably provided at the side facing toward the door with a stop member, for example, in the form of a lug which is bent at a right angle to the link and projects into the plane of travel of the end of the bell crank. This stop member thus limits the movement of the bell crank during the closing stroke of the piston in the cylinder and prevents the individual door wings from being turned beyond the fully closed position. It therefore insures that the entire door will be fully closed and remain closed until the piston in the cylinder is again actuated to open the door.

These and other objects, features, and advantages of the present invention will become further apparent from the following detailed description thereof, particularly when the same is read with reference to the accompanying drawings, in which—

FIGURE 1 shows a perspective view of the rear part of a bus with a four-wing door according to the invention;

FIGURE 2 shows a side view of the four-wing door alone;

FIGURE 3 shows a diagrammatic view of the operating mechanism for a door according to FIGURES 1 and 2;

FIGURE 4 shows a diagrammatic view of the guiding means for the lower side of a door according to FIGURES 1 and 2;

FIGURE 5 shows a top view of the operating mechanism for one pair of door wings of a door according to FIGURES 1 to 3;

FIGURE 6 shows a top view of the guiding means for the lower side of the door; while

FIGURE 7 shows a top view of the operating mechanism according to a modification of the invention.

Referring to the drawings, FIGURES 1 and 2 illustrate a door, according to the invention, and generally indicated at **10**, which is installed within the outwardly curved side wall **11** of a bus **12** near the rear axle **13**. This door **10** consists of four separate swinging door wings **14**, **14'**, **15**, and **15'** which are of a substantially equal size and shape and are adapted to be opened from the center of the door opening toward both sides. When thus being opened, door wings **14** and **14'** of the rear half of the door are moved in the longitudinal direction of the bus toward the rear, and door wings **15** and **15'** of the front half of the door toward the front, while at the same time the two wings of one pair are both turned at an angle of about 90° about their vertical axes in one direction and those of the other pair in the opposite direction. In the open position, the two pairs of door wings **14**, **14'** and **15**, **15'** rest at the opposite sides of the door opening within a shallow door niche, and the curved sides of the two wings of each pair will then fully engage with each other, as indicated in dot-and-dash lines in FIGURE 2. In this position the door wings will take up very little space and leave almost the entire width of the door opening completely free.



The individual door wings are not connected to each other by any hinges or similar means. In the closed position they are sealed relative to each other by sealing strips **16**. As subsequently described in detail, each door wing is suspended on a suitable pilot pin which engages into a guide rail at the upper side **17** of the door frame which supports the top of the bus. Each of these upper pilot pins is mounted approximately within the axis of symmetry of the respective door wing so that, when the latter is in the fully open position, approximately one-half of it will project outwardly and the other half inwardly from the outer wall of the bus. At the bottom end of the door, each door wing will be guided by means of a lever arrangement which will also be subsequently described in detail.

The entire door may be operated by a single control element, for example, a pneumatic or hydraulic cylinder, which is actuated by an auxiliary force, and by special power-transmitting means, for example, a system of levers. This is illustrated diagrammatically in FIGURE 3 which shows a pneumatic or hydraulic cylinder **18** which is pivotably mounted at or above the upper side **17** of the door frame and is adapted to operate both pairs of door wings, only one pair of which together with its connecting elements is shown since the other pair and its connecting elements is arranged symmetrically thereto and is of the same construction. For this purpose, piston rod **19** extending from cylinder **18** is connected through a double crank **20** and two connecting rods **21** and **21'** to two journals **22** (only one of which is shown) which are mounted at the opposite sides toward which the door wings are opened. The door wings **14** and **14'**, respectively, are suspended from a guide rail **24** which is mounted on the upper side **17** of the door frame by pilot pins **23** and **23'** which engage into the guide rail **24**. The guide rail **24** may, if desired, extend across the entire width of the door.

The lever arrangements for operating each door wing **14** and **14'** are in principle the same and it is therefore only necessary to describe the arrangement for one door wing. Pilot pin **23'** of door wing **14'** is pivotally connected to a knee lever consisting of arms **25** and **26** which are connected by a pivotal joint **27**. Arm **25** is secured to journal **22** so as to rotate therewith during its movement.

Thus, if the piston in cylinder **18** is driven forwardly, piston rod **19** will pivot crank **20** and through connecting rod **21** turn journal **22** in a counterclockwise direction so that arms **25** and **26** will bend relative to each other at joint **27** to the position as indicated in dot-and-dash lines, whereby door wing **14'** will be shifted within its guide rail **24** in the longitudinal direction of the bus.

At the same time, however, door wing **14'** must also rotate about pilot pin **23'** so that, when it is in its final position as indicated in dot-and-dash lines, it will extend substantially at a right angle to the outer wall of the vehicle. For this purpose, an arm **28** is rigidly connected

to door wing 14' and pivotally connected to arm 26 by the pivot pin 23'. Arm 28 is also connected to arm 25 connected by a connecting rod 29 so that, when the two arms 25 and 26 of the knee lever bend relative to each other, door wing 14' will be turned about the pivot pin 23' about a right angle, that is, about a greater angle than the knee lever itself is turned. In order to accomplish this, the two ends of connecting rod 29 are located at opposite sides of arm 26 and this rod 29 thus crosses the latter.

Summarizing the operation of the door opening lever system described above, when the journal 22 turns counterclockwise the lever 25 is also forced to move with a counterclockwise rotation about journal 22. This movement of lever 25 pulls lever 26 to the outside edge of the door since lever 26 is secured to pin 23' which is in turn guided within rail 24. Simulaneously with the movement of lever 25, lever 29 also rotates but with a clockwise movement through the connection thereof to the lever 25 and lever 28. This movement of lever 29 causes rotation of lever 28 clockwise about the pin 23' and, since the lever 28 is rigid with door wing 14', also a clockwise rotation of door wing 14' about pin 23'.

This entire operating mechanism is mounted on the frame which supports the top of the vehicle. At the lower side, the door wings are guided by a similar lever arrangement and therefore carry out the identical movements at both ends. However, it is advisable to avoid the use of a guide rail at the lower side since it would easily become clogged with dirt. As illustrated in FIGURE 4, door wing 14' is therefore connected to a journal 32 by a knee lever with arms 30 and 31 of a type which is similar in principle to that which is formed by arms 25 and 26. The position of journal 32 may correspond to that of the upper journal 22, but may also vary therefrom. The end 33 of knee lever 30, 31 is supported by a further lever arrangement 34, 35, and 36 which is pivotable about two stationary bearing points 37 and 38, respectively. Arm 34 of this lever arrangement forms a rigid bell crank. The length and position of the different arms of this lever arrangement and the position of its stationary bearing points are designed so as to insure that the respective door wing will at the lower side be guided along a path which corresponds to that of the upper side. The other door wing 14 may be guided at the lower side in substantially the same manner as door wing 14' except that the knee lever is in this case merely braced by a single lever 39 which is pivotable about a stationary bearing point 40.

FIGURE 5 shows a preferred embodiment of the operating mechanism according to the invention for one of the door wings, which corresponds in principle to the diagrammatic illustration according to FIGURE 3. However, in this case, journal 22 is mounted in a fixed position and the arms, which in FIGURE 3 are rigidly secured to journal 22, now form a plate 41 which is pivotable about journal 22 and constitutes a bell crank. This plate 41 is, in turn, pivotably connected at one side to the piston rod 19 of the hydraulic cylinder 18 and at the other side to an angular arm 42 which is pivotably connected to pilot pin 23 on door wing 14. This angular arm 42 together with bell crank plate 41 forms the knee-lever connection to pilot pin 23. A further knee-lever connection 43, 44, one arm 44 of which is a rigid part of an arm 45 which is secured to the door wing, effects the rotation of the door wing to the open position, as indicated in FIGURE 5 in dot-and-dash lines. Pilot pin 23 on arm 45 is guided within a guide rail 24. Each pilot pin 23 at the upper side of the different door wings is disposed within the vertical plane of symmetry of the respective wing, whereas at the lower side, as shown in FIGURE 4, the points of connection 46 and 46' of the knee levers to the door wings is shifted relative to the plane of symmetry and the center of the door wing to such an extent that the points which correspond to pilot pins 23 and 23' will carry out a rectilinear movement.



The operation of the device of FIGURE 5 is similar to that of FIGURE 3 with bell crank 41 and arms 42, 44 and 43 corresponding, respectively, to levers 25, 26, 28 and 29.

FIGURE 6 shows a preferred embodiment of the guiding means for the lower side of the door wings in accordance with the diagrammatic illustration according to FIGURE 4. Journal 32 which is mounted in a fixed position on a mounting plate 48 supports a pivotable member 49 which forms the knee-lever arms 30 and 50 for both door wings 14 and 14'. The fixed pivots 40, 37, and 38 for bracing the knee-lever arms are also secured to mounting plate 48. The dot-and-dash lines in FIGURE 6 again illustrate the position of the various elements when both door wings are fully opened.

FIGURE 7 illustrates a modification of the invention, in which the lever arrangement according to the invention is designed so as to take up only very little space at the inside of the vehicle so that it does not reduce the free height within the vehicle above the door.

Similarly as in the first embodiment, as illustrated in FIGURES 3 and 5, each half of the door 10 consists of two door wings 14 and 14' which are not directly connected to each other by any hinges, but only indirectly by means of a suitable lever mechanism above and below the door. The individual door wings are again provided with sealing strips 16 for sealing the adjacent door wings relative to each other when the door is in thec losed position. Pilot pins 51 and 51' which are mounted on the upper end of each door wing 14 and 14', respectively, engage into a guide rail 52 which is mounted on the top of the vehicle. The operation of the door is again effected by a pneumatic or hydraulic cylinder 18 or similar means through a piston rod or connecting rod 21 and a crank arm 53, only indicated diagrammatically, which is rigidly secured to a journal 54 which is rotatably mounted in a fixed position laterally of and above the door opening and has a bell crank 55 rigidly secured thereto. Naturally, crank arm 53 may also be integral with bell crank 55 in which event the entire bell crank is pivotable about journal 54 which is then rigidly secured to the top frame of the vehicle. Also similarly as in the first embodiment, bell crank 55 and door wings 14 and 14' are connected by a knee lever which, when bell crank 55 is pivoted by the operation of the piston in cylinder 18, turns both door wings 14 and 14' and also moves them within guide rail 52 in the longitudinal direction of the vehicle toward one side of the door opening.

This knee-lever arrangement, at least for the operation of the door wing 14' which faces toward the center of door 13, consists of an arm 56 which is secured to pilot pin 51 and connected to bell crank 55 through two intermediate arms 57 and 58 which are both pivotably connected to bell crank 55 as well as to arm 56. The two arms 57 and 58 are disposed in a geometrical arrangement to each other so that, when bell crank 55 is pivoted, door wing 14 will be turned about an angle of approximately 90° and will at the same time be shifted toward the side of the door frame, as indicated in dot-and-dash lines.

Arm 56 is preferably made of substantially the same length as bell crank 55 and of a length corresponding to approximately one-half of the width of the door wing. If the arms are made of these dimensionse the entire knee-lever mechanism will take up practically no more space than the door wings or the depth of the door niche when the door is in the open position as shown in dot-and-dash lines.

While the intermediate arm 57 is pivotably connected to the end of arm 56 which is mounted on door wing 14', the other intermediate arm 58 is pivotably connected to arm 56 at a certain distance from this end. Substantially at its point of connection with arm 58, arm 56 is also bent slightly in the direction toward the door.

The pivotal connections of arms 57 and 58 with bell

crank 55 are directly inverse to those with arm 56, insofar as the intermediate arm 58 is connected to the end of bell crank 55 but to arm 56 at a certain distance from its end, while the other intermediate arm 57 is connected to the end of arm 56 and to the bell crank at 59 at a certain distance from its end. As illustrated in FIGURE 7, when the door is being opened, the two intermediate arms 57 and 58 will cross each other. Arm 58 is preferably also slightly bent at its center 60 in the direction opposite to the bend in arm 56, that is, away from the door.

The intermediae arm 57 is further provided at the side facing toward the door with a lug 61 which is bent at a right angle to arm 57 and serves as a stop which extends either upwardly or downwardly into the plane of travel of bell crank 55 so that, when the door is in the closed position, the end of bell crank 55 will engage with this stop which will then also limit the extent of the closing stroke of the piston in cylinder 13 so that at the end of the closing movement, the individual door wings cannot turn beyond the closed position of door 10.

The lever arrangement on the other door wing 14 adjacent to the door niche may be of the same design as that above described, although it is also possible to apply the knee-lever system as shown in FIGURES 3 and 5, since the arms thereof are very short and will not project in the vehicle above the door opening.

The lower side of door wings 14 and 14' according to FIGURE 7 may be guided by a lever arrangement similar to that as shown in FIGURES 4 and 6.

Although our invention has been illustrated and described with reference to the preferred embodiments thereof, we wish to have it understood that it is in no way limited to the details of such embodiments, but is capable of numerous modifications within the scope of the appended claims.

Having thus fully disclosed our invention, what we claim is:

1. A door adapted to close a door opening in a wall, especially the outer wall of a vehicle, and be substantially flush with said wall, comprising a plurality of individual swinging door wings, said plurality of individual door wings including at least two adjacent door wings, and means for essentially simultaneously and independently turning each of said door wings separately in the same direction about a vertical axis and, substantially simultaneously with said turning, for sliding said door wings from the closed position toward a lateral side of said door opening, said turning and sliding means including at least one guide rail mounted adjacent one end of said door and extending essentially in the longitudinal direction of the door opening, separate members secured to said one end of each of said door wings and pivotally engaging within and slidable along said guide rail, driving means, and a separate lever system independently connecting said driving means with each said member for simultaneously turning said member and the door wing thereon and sliding the same along said guide rail until all of said door wings extend substantially parallel to each other and substantially at right angles to said wall with the normally inner side of each of said door wings facing toward the center of said door opening and with the door wings closely adjacent to the respective side of said door opening, each said lever system including for its respective door wing a first lever means for sliding the respective member along said guide rail operatively connected to said member, said first lever means being operatively connected to said driving means, and second lever means operatively connecting said member with said driving means for simultaneously turning said door wing about its axis during the sliding thereof, whereby when said first lever means slides said member along said guide rail, said second lever means turns said door wing.

2. A door as defined in claim 1, wherein said members are secured to the upper ends of said door wings, and further including an additional lever means secured to the lower ends of said door wings for guiding said door wings at said lower end along a path corresponding essentially to the path followed by the upper end thereof during movement of said upper end by said turning and sliding means.

3. A door as defined in claim 2, wherein said additional lever means comprises for each door wing a pair of levers pivotably connected at one end to each other, one of said levers being secured at the other end thereof to the lower end of the respective door wing, the other lever being pivotable about a fixed point, and additional lever means pivotably connected to said first lever for guiding the same.

4. A door as defined in claim 1, wherein each said first lever means comprises a knee lever consisting of a first arm pivotally mounted on a fixed pivot and operatively connected to said driving means for rotation thereby and a second arm pivotally connected to said first arm and to said member, whereby when said first arm is rotated said second arm and said member are pulled therewith and said member slides along said guide rail.

5. A door as defined in claim 4, wherein said second lever means comprises a separate arm pivotally connected to said member and said first arm of said knee lever on the opposite side thereof with respect to said second arm to thereby cross the latter, whereby simultaneously with said sliding movement said member is rotated and therewith said door wing is rotated as it slides along said guide rail.

6. A door as defined in claim 1, in which said first and second lever means comprise a lever secured to each door wing adjacent to the center thereof and a pair of links for each door wing, said lever systems further including a bell crank pivotably mounted on a fixed pivot and means for pivotably connecting said driving means to said bell crank to pivot the same, each of said links of said lever means being pivotably connected at its ends to the lever secured to its respective door wing and to said bell crank and in a spaced relation to the connecting points of the other link of the respective pair on said lever and said bell crank.

7. A door as defined in claim 6, in which each said lever on said door wings and said bell crank have substantially the same length, said length being substantially equal to the width of one-half of each door wing.

8. A door as defined in claim 6, in which one of the links of each said pair is pivotably connected at one end to the free end of the lever on the respective door wing and at the other end to said bell crank at a point spaced from the end thereof, and in which the other link of each said pair is pivotably connected at one end to said last-mentioned lever at a point spaced from the end thereof and at the other end to the end of said bell crank.

9. A door as defined in claim 8, in which said one link has a projection thereon serving as a stop, said bell crank being adapted to engage with said stop when said door wing is in the fully closed position in line with said wall.

10. A door as defined in claim 9, in which said lever is bent slightly at the point of connection with said other link in the direction toward the plane of said door when in the closed position.

11. A door as defined in claim 10, in which said other link is slightly bent substantially at the center thereof in the direction opposite to the bend in said lever.

12. A door adapted to close a door opening in a wall, especially the outer wall of a vehicle, and be substantially flush with said wall, comprising a plurality of swinging door wings, said plurality of individual door wings including at least two adjacent door wings, and means for essentially simultaneously and independently turning each of said door wings separately in the same direction about a vertical axis extending substantially centrally of each individual door wing, and, substantially simultaneously

with said turning, for sliding said door wings from the closed position toward a lateral side of said door opening, said turning and sliding means including at least one guide rail mounted adjacent one end of said door and extending essentially in the longitudinal direction of the door opening, separate members secured to said one end of each of said door wings and engaging with and slidable along said guide rail, driving means, and a separate lever system independently connecting said driving means with each said member for simultaneously turning said member and the door wing thereon and sliding the same along said guide rail until all of said door wings extend substantially parallel to each other and substantially at right angles to said wall with the normally inner side of each of said door wings facing toward the center of said door opening and with the door wings closely adjacent to the respective side of said door opening, each said lever system including for its respective door wing a knee lever for sliding said member along said guide rail comprising a pair of arms pivotably connected to each other, one of said arms being pivotably connected to said member, and the other of said arms forming a bell crank pivotably mounted on a fixed pivot, means for connecting said driving means to said bell crank to pivot the same, said lever system further including additional lever means operatively connected to said member and said knee lever for turning said member and said door wing thereon from a position in line with said wall to a position substantially at a right angle thereto when said knee lever slides said member along said guide rail, and guide means secured to the other end of each said door wing for guiding said other end of said door wing during the sliding and turning movements thereof along a path essentially corresponding to the path followed by said one end of the door wings during sliding thereof, said guide means comprising for each door wing a pair of levers pivotably connected at one end to each other, one of said levers being secured at the other end thereof to said other end of the respective door wing, the other lever being pivotable about a fixed point, and further lever means pivotably connected to said first lever for guiding the same.

13. A door as defined in claim 12, in which each of said members is secured substantially centrally to the upper end of its respective door wing, and each of said one of the levers of said guide means being secured to the lower end of its respective door wing at a point slightly spaced from the center of said door wing in the direction toward the center of said entire door.

14. A door adapted to close a door opening in a wall, especially the outer wall of a vehicle, and be substantially flush with said wall, comprising a plurality of individual swinging door wings together adapted to fully close said opening, said door having at least two of said door wings at each side thereof, and means for essentially simultaneously and independently turning each of said door wings for one side of said door separately in one direction and those of the other side separately in the opposite direction about a vertical axis extending substantially centrally of each individual door wing, and, substantially simultaneously with said turning, for independently sliding said door wings forming one side of said door from the closed position toward one lateral side of said door opening and those forming the other side of said door toward the opposite lateral side of said door opening, said turning and sliding means including at least one guide rail mounted adjacent the upper end of said door wings and extending essentially in the longitudinal direction of the door opening, a member secured to the upper end of each of said door wings and engaging with and slidable along said guide rail, driving means, separate journals driven by said driving means mounted adjacent each side of said door opening, and a separate lever system independently connecting the members for the door wings of each side of said door to the journal secured adjacent the respective side of said door opening for simultaneously turning said members and the door wings thereon and sliding the same along said guide rail until all of said door wings extend substantially parallel to each other and substantially at right angles to said wall with the normally inner side of each of said door wings facing toward the center of said door opening and the door wings of each side of said door are disposed closely adjacent and substantially parallel to each other and closely adjacent to the respective side of said door opening, each said lever system including for its respective door wing a first lever means for sliding the respective member along said guide rail operatively connected to said respective member, said first lever means being operatively connected to said driving means, and second lever means operatively connecting said member with said driving means for simultaneously turning said door wing about its axis during the sliding thereof, whereby when said first lever means slides said member along said guide rail, said second lever means turns said door wing, and additional lever means secured to the lower ends of said door wings for guiding said door wings at said lower end along a path corresponding essentially to the path followed by the upper end thereof during movement of said upper end by said turning and sliding means.

15. A door adapted to close a door opening in a wall, especially the outer wall of a vehicle, and be substantially flush with said wall, comprising a plurality of individual swinging door wings, said plurality of individual door wings including at least two adjacent door wings, and means for essentially simultaneously and independently turning each of said door wings separately in the same direction about a vertical axis and, substantially simultaneously with said turning, for sliding said door wings from the closed position toward a lateral side of said door opening, said turning and sliding means including at least one guide rail mounted adjacent one end of said door and extending essentially in the longitudinal direction of the door opening, separate members secured to said one end of each of said door wings and pivotally engaging within and slidable along said guide rail, driving means, and a separate lever system independently connecting said driving means with each said door wing for simultaneously turning said door wing around said member and sliding the same along said guide rail until all of said door wings extend substantially parallel to each other and substantially at right angles to said wall with the normally inner side of each of said door wings facing toward the center of said door opening and with the door wings closely adjacent to the respective side of said door opening, each said lever system including for its respective door wing a first lever means for turning and sliding the respective door wing with its member along said guide rail, said first lever means being operatively connected to said driving means and to said one end of its respective door wing, and further lever means operatively connected to the other end of the respective door wing for guiding the respective door wing in a manner substantially similar to the movements imparted to said one end thereof by said first lever means.

16. A door adapted to close a door opening in a wall, especially the outer wall of a vehicle, comprising a plurality of individual swinging door wings having a closed position adapted to fully close said door opening, said plurality of individual swinging door wings including at least two adjacent door wings, each of said two adjacent door wings having individual vertical pivot axis means, and means for essentially simultaneously and independently turning each of said two adjacent door wings in the same direction about their respective individual vertical pivot axis means and, substantially simultaneously with said turning, for sliding said two adjacent door wings from the closed position thereof toward one lateral side of said door opening, said last-mentioned turning and sliding means including at least one guide rail mounted at one end of said door and extending essentially

in the longitudinal direction of the door opening, driving means, and separate lever means for each door wing independently connecting the individual vertical pivot axis means of the respective door wing with said driving means for simultaneously and independently turning and sliding the respective door wing along said guide rail, whereby upon actuation of said driving means and with said door wings in the closed position thereof, said door wings are simultaneously and independently turned and slid along said guide rail into an open position wherein said door wings extend substantially parallel to each other and at substantially right angles to said wall.



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